Docket No.: SMQ-082CN2/P6396CNT1
(PATENT)

IN THE UNITED STATES PATENT AND TRADEMARK OFFICE

In re Patent Application of:
John Teloh *et al.*

Application No.: 09/988,854   Confirmation No.: 9383

Filed: November 19, 2001   Art Unit: 2165

For: Storage Network Data Replicator   Examiner: Neveen Abel Jalil

APPEAL BRIEF

MS Appeal Brief - Patents
Commissioner for Patents
P.O. Box 1450
Alexandria, VA 22313-1450

Dear Sir:

As required under § 41.37(a), this brief is filed within five months of the Notice of Appeal filed in this case on December 19, 2005 and is in furtherance of said Notice of Appeal.

The fees required under § 41.20(b)(2), and any required petition for extension of time for filing this brief and fees, are dealt with in the accompanying TRANSMITTAL OF APPEAL BRIEF.

This brief contains items under the following headings as required by 37 C.F.R. § 41.37 and M.P.E.P. § 1206:

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I.   REAL PARTY IN INTEREST

The real party in interest for this appeal is:

Sun Microsystems, Inc.

II.   RELATED APPEALS AND INTERFERENCES

Related U.S. Patent Application Serial No.'s 09/905,436 and 09/988,853 are currently under appeal. An Appeal Brief in U.S. Patent Application Serial No. 09/905,436 was filed on April 24, 2006 and an Appeal Brief in U.S. Patent Application Serial No. 09/988,853 was filed on September 26, 2005 and an Examiner's Answer to Appeal Brief was mailed on December 12, 2005.

III.   STATUS OF CLAIMS

A.   Total Number of Claims in Application

There are 31 claims pending in application.

B.   Current Status of Claims

    1.   Claims pending: 1-31

    2.   Claims rejected: 1-4, 6-22 and 24-31

    3.   Claims objected to: 5 and 23

C.   Claims On Appeal

The claims on appeal are claims 1-4, 6-22 and 24-31

IV.   STATUS OF AMENDMENTS

Applicant did not file an Amendment after Final Rejection.

V.   SUMMARY OF CLAIMED SUBJECT MATTER

The claimed invention provides a solution to overcome the shortcomings of conventional data transmission connections. Such conventional connections include enterprise system connections and fiber arbitrated loops that are not able to provide the necessary long distance separation between an operational work center and the data repository to overcome regional disasters without the use of high cost of dedicated transmission mediums, such as a high-speed fiber optic cable. The claimed invention also provides a solution for communication issues between sites hosting a storage device and a solution to synchronize the distributed data after the communication issues are resolved. In general, the claimed invention relates to providing a method and system enabling and re-establishing remote data mirroring amongst multiple remote storage devices across data transmissions paths having various transmission capabilities and remote mirroring sites operating on various operating platforms.

In one aspect of the claimed invention, the claimed invention allows a first network location to update a replica held by a physically remote storage device in a storage network. At the first network location, a first data replication facility of a first electronic device in the storage network is instructed to log in a log one or more writes to a local storage device when a first replica held by the physically remote storage device cannot be updated due to a detected error condition in the storage network. The first electronic device determines if the detected error condition that prevents updating of the first replica held by the physically remote storage device still exists in the storage network. Upon determination by the first electronic device that the first replica held by the physically remote storage device can be updated due to a removal of the detected error condition that prevents updating of the first replica held by the physically remote storage device the first data replication facility of the first electronic device is instructed to replicate the data corresponding to the one or more writes identified in the log to generate a second replica. In turn, the second replica is outputted in accordance with a communication protocol from the first electronic device to a second data replication facility of a second electronic device of the physically remote storage device in the storage network to update the first replica. Transmission between the originating location and the remote location can occur in a stateless manner using the TCP/IP protocol suite.

In another aspect of the claimed invention, the claimed invention manages a communication link failure in a computer network that supports replication of data amongst a number of programmable electronic devices in the computer network. Each of the programmable electronic devices operates as a host device for a data replication facility. Upon detection of a communication link failure by one of the host devices, each of the data replication facilities of each of the programmable electronic devices is instructed to enter a logging routine. The logging routine halts the replication of data by the replication facility of the host device and the replication facility of the host device identifies in a log each local write of the host device that detects the communication link failure. Upon reestablishment of the communication link each data replication facility of each of the programmable electronic devices that initiated the logging routine is instructed to generate a replica for each local write identified in the log.

As defined by independent claim 1, Appellant's invention relates to a method performed in a storage network (10) to update a first replica held by a physically remote storage device (26, 26') in the storage network (Page 7, lines 17-19). Performance of the method instructs a first data replication facility (120) of a first electronic device (16) in the storage network (10) to log (80) one or more writes to a local storage device (24) when the first replica held by the physically remote storage device (26) cannot be updated due to a detected error condition in the storage network as well as determines at the first electronic device (16) if the detected error condition still exists in the storage network (10) that prevents updating of the first replica held by the physically remote storage device (26) (Page 7, lines 19-23). In accordance with the steps defined by the method, performance of the method instructs the first data replication facility (20) of the first electronic device (16) to replicate data corresponding to the one or more writes identified in the log (80) to generate a second replica upon determination by the first electronic device (16) that the first replica held by the physically remote storage device (26) can be updated due to a removal of the detected error condition that prevents updating of the first replica held by the physically remote storage device (26) (Page 7, lines 23-24). In turn, performance of the method outputs the second replica in accordance with a communication protocol from the first electronic device (16) to a second data replication facility (20') of a second electronic device (18) of the physically remote storage device (26) in the storage network (10) to update the first replica (Page 7, lines 22-23).

Dependent claim 2 depends from independent claim 1 and further includes the step of identifying to the first data replication facility (20) of the first electronic device (16) which of the one or more writes to the local storage device should not be logged (80) when the physically remote storage device (26) cannot be updated (Page 15, line 31 to Page 16, line 3).

Dependent claim 3 depends from independent claim 1 and further includes the step of instructing the first data replication facility (20) of the first electronic device (16) to automatically output the second replica to the second replication facility (20') once generation of the second replica is complete (Page 16, lines 3-5).

. Dependent claim 4 depends from independent claim 1 and further includes the step of instructing the first replication facility (20) of the first electronic device (16) to prompt an operator of the first replication facility (20) in order to obtain authorization for the output of the second data replica to the second data replication facility (20') of the second electronic device (18) to update the first replica (Page 12, lines 6-10).

Dependent claim 5 depends from independent claim 1 and further includes the steps of instructing the first replication facility (20) of the first electronic device (16) to halt logging of the one or more writes to the local storage device (24) upon the determination that the first replica can be updated, and instructing the first replication facility (20) of the first electronic device (16) to initiate generation of the second replica upon the determination that the first replica can be updated (Pages 7, lines 19-24).

Dependent claim 6 depends from independent claim 1 and further includes the step of instructing the second replication facility (20') of the second electronic device (18) to log the one or more writes to a second local storage device (26) of the second electronic device (18) (Page 12, lines 4-6).

Dependent claim 7 depends from dependent claim 6 and further includes the steps of, detecting an available communication link in the storage network (10) between the first electronic device (16) and the second electronic device (18) to transport data between the first

electronic device (16) and the second electronic device (18), prompting the system operator to select a primary replication facility (20) and a secondary replication facility from amongst the first replication facility (20) of the first electronic device (16) and the second replication facility (20') of the second electronic device (18), upon selection by the system operator, instructing the primary replication facility (20, 20') to generate the second replica of data identified in the log (80), and instructing the primary replication facility (20, 20') to output the second replica for transmission to the secondary replication facility (20, 20') via the available communication link (28) to update said first replica (Page 12, lines 1-12).

Dependent claim 8 depends from independent claim 1 and further includes the step of forwarding from said first data replication facility (20) of said first electronic device (16) to said second data replication facility (20') at said second electronic device (18) information identifying a storage location on said physically remote storage device (26) for storage of said second replica (Page 12, lines 27-29).

Dependent claim 9 depends from independent claim 1 and further includes the limitation that the outputting from said first data replication facility (20) of said first electronic device (16) to said second data replication facility (20') of said second electronic device (18) occurs in a synchronous manner (Page 12, lines 14-15).

Dependent claim 10 depends from independent claim 1 and further includes the limitation that the communication protocol includes the Transmission Control Protocol/Internet Protocol (TCP/IP) protocol suite (page 10, lines 24-26).

Dependent claim 11 depends from independent claim 1 and further includes the limitation includes the limitation that the first electronic device and the second electronic device operate without a volume manager facility (page 8, lines 27-28).

Dependent claim 12 depends from independent claim 1 and further includes the limitation that the log (80) includes a bitmap holding one or more bits and each of the one or more bits in the bit map indicates a storage location written to on the local storage device (24) (Page 14, line 30 to page 15, line 1).

As defined by independent claim 13, Appellant's invention relates to a method to handle a communication link failure in a computer network (10) having a number of programmable electronic devices (16, 18) (Page 15, lines 29-31). Each of the programmable electronic devices operates as a host device for a data replication facility (20, 20') for replicating data amongst the programmable electronic devices (16, 18). Performance of the method instructs each data replication facility of each programmable electronic device to enter a logging routine should the host device of the data replication facility detect a communication link failure (Page 12, lines 4-6). The logging routine halts replication of data by the replication facility of the host device and the replication facility of the host device identifies in a log each local write of the host device that detects the communication link failure (Page 15, lines 29 to Page 16, line 5). Performance of the method instructs each data replication facility (20, 20') of each programmable electronic device (16, 18) that initiated the logging routine to generate a replica for each the local write identified in the log upon reestablishment of the communication link (Page 11, lines 29-31).

Dependent claim 14 depends from independent claim 13 and further includes the steps of grouping each replica into a single data set and forwarding the single data set in accordance with a communication protocol from a first of the programmable electronic devices to a second of the programmable electronic devices (Page 16, lines 10-13).

Dependent claim 15 depends from dependent claim 14 and further includes the step of packaging with the single data set information identifying a storage location for storage of the single data set on a storage device (26) of the second programmable electronic device (20) (page 12, lines 27-29).

Dependent claim 16 depends from dependent claim 14 and further includes the limitation that the first programmable electronic (16) device forwards the single data set in a synchronous manner (Page 12, lines 14-15).

Dependent claim 17 depends from dependent claim 14 and further includes the limitation that communication protocol comprises the Transmission Control Protocol/Internet Protocol (TCP/IP) protocol suite (Page 10, lines 24-26).

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Dependent claim 18 depends from dependent claim 13 and further includes the limitation that each of the programmable electronic devices (16, 18, 18') in the computer network (10) operate without a volume manager facility (Page 8, lines 27-28).

As defined by independent claim 19, Appellant's invention relates to a computer readable medium holding computer executable instructions to perform a method in a storage network (10) to update a first replica held by a physically remote storage device (26, 26') in the storage network (Page 7, lines 17-19). The method embodied on the medium includes the step of instructing a first data replication facility (20) of a first programmable electronic device(16) in the storage network (10) to enter a first state to log (80) one or more writes to a local storage device (24) when the first replica held by the physically remote storage device (26) cannot be updated due to a detected error condition that does not allow transmission of data to the physically remote storage device (26) (Page 7, lines 19-23). The method embodied on the medium includes the step of determining at the first programmable electronic device (16) if the first replica held by said physically remote storage device (26) can be updated due an abatement of the detected error condition (Page 7, lines 21-23). Execution of the instructions held on the medium instructs the first data replication facility (20) of the first programmable electronic device (16) to replicate data corresponding to the one or more writes identified in the log (80) in order to create a second replica upon determination by the first programmable electronic device (16) that the first replica held by the physically remote storage device (26, 26') can be updated (Page 7, lines 23-29). In accordance with the executed instructions held by the computer readable medium, the second replica is output in accordance with a communication protocol from the first programmable electronic device (16) to a second data replication facility (20') of a second programmable electronic device (18) in communication with the physically remote storage device (26) in the storage network (10) to update the first replica (Page 7, lines 22-23).

Dependent claim 20 depends from independent claim 19 and further includes the step of identifying to the first data replication facility (20) of the first programmable electronic device (16) which of the one or more writes to the local storage device (24) should not be logged when the physically remote storage device (26) cannot be updated (Page 15, line 31 to Page 16, line 3).

Dependent claim 21 depends from independent claim 19 and further includes the step of instructing the first data replication facility (20) of the first programmable electronic device (16) to automatically transmit the second replica to the second replication facility (20') once creation of the second replica is complete (Page 16, lines 3-5).

Dependent claim 22 depends from independent claim 19 and further includes the step of, at the first replication facility (20) of the first programmable electronic device (16), prompting an operator of the first replication facility (20) to obtain permission for the outputting of the second data replica to the second data replication facility (20') of the second programmable electronic device (18) to update the first replica (Page 12, lines 6-10).

Dependent claim 23 depends from independent claim 19 and further includes the steps of instructing the first replication facility (20) of the first programmable electronic device (16) to exit the first state upon the determination that the first replica can be updated and instructing the first replication facility (20) of the first programmable electronic device (16) to enter a second state to initiate creation of the second replica upon the determination that the first replica can be updated (Page 7, lines 19-24).

Dependent claim 24 depends from independent claim 19 and further includes the steps of detecting a communication link failure in the storage network (10) between the first programmable electronic device (16) and the second programmable electronic device (18) and instructing the second replication facility (20') of the second programmable electronic device (18) to enter the first state to log one or more writes to a second local storage device (26) coupled to the second programmable electronic device (18) (page 12, lines 4-6).

Dependent claim 25 depends from dependent claim 24 and further includes the steps of detecting an available communication link (28) in the storage network (10) between the first programmable electronic device (16) and the second programmable electronic device (18) to transport data between the first programmable electronic device (16) and the second programmable electronic device (18), prompting the system operator to select a primary replication facility and a secondary replication facility from amongst the first replication facility

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(20) of the first programmable electronic device (16) and the second replication facility (20') of the second programmable electronic device (18), upon selection of the primary replication facility (20, 20') by the system operator, instructing the primary replication facility to enter the second state to create the second replica of data identified in the first state, and instructing the primary replication facility (20, 20') to output the second replica for transport via the available communication link (28) in the storage network (10) to the secondary replication facility (20, 20') to update the first replica (page 12, lines 1-12).

Dependent claim 26 depends from independent claim 19 and further includes the step of forwarding from the first data replication facility (20) of the first programmable electronic device (16) to the second data replication facility (20) at the second programmable electronic device (18) information identifying a storage location on the physically remote storage device (26) for storage of the second replica (Page 12, lines 27-29).

Dependent claim 27 depends from independent claim 19 and further includes the limitation of using a synchronous manner when to transport data from the first data replication facility (20) of the first programmable electronic device (16) to the second data replication facility (20') of the second programmable electronic device (18) (Page 10, lines 5-6 and FIG. 2).

Dependent claim 28 depends from dependent claim 19 and further includes the limitation that the communication protocol is the Transmission Control Protocol/Internet Protocol (TCP/IP) protocol suite (page 10, lines 24-26).

Dependent claim 29 depends from independent claim 19 and further includes the limitation that the first programmable electronic device and the second programmable electronic device operate without a volume manager facility (page 8, lines 27-28).

Dependent claim 30 depends from independent claim 19 and further includes the limitation that the log (80) includes a bitmap to hold one or more pointers and each of the one or more pointers indicate a location on a storage device written to during the first state (Page 14, lines 30 to page 15, line 1).

As defined by independent claim 31, Appellant's invention relates to a method to update a first replica held by a physically remote storage device (26, 26') in a storage network (10)(Page 7, lines 17-19). The method includes the step of instructing a first data replication facility (20) of a first electronic device (16) in the storage network (10) to log one or more writes to a local storage device (16) when the first replica held by the physically remote storage device (26) cannot be updated due to a detected error condition in the storage network (10) (Page 7, lines 19-23). Performance of the method determines at the first electronic device (16) if the detected error condition still exists in the storage network (10) that prevents updating of the first replica held by the physically remote storage device (26) (Page 7, lines 19-23). Upon determination by the first electronic device (16) that the first replica held by the physically remote storage device (26) can be updated due to a removal of the detected error condition that prevents updating of the first replica held by the physically remote storage device (26) the first data replication facility (20) of the first electronic device (16) is instructed to replicate data corresponding to the one or more writes identified in the log (80) to generate a second replica (Page 7, lines 23-24). Further, upon the determination that the first replica can be updated the first replication facility (20) of the first electronic device (16) is instructed to halt logging of the one or more writes to the local storage device (24) (Page 7, lines 19-24). In turn, performance of the method outputs the second replica in accordance with a communication protocol from the first electronic device (16) to a second data replication facility (20') of a second electronic device (18) of the physically remote storage device (26) in the storage network (10) to update the first replica (Page 7, lines 22-23).

VI.   ISSUES TO BE REVIEWED ON APPEAL

Claims 1-4, 6-22 and 24-31 are rejected under U.S.C. §103(a) as being unpatentable over United States Patent No. 5,613,079 to Debique et al. ("Debique") in view of United States Patent No. 6,629,264 to Sicola et al. ("Sicola").

VII.   ARGUMENT

A. Rejection of Claims 1-4, 6-22 and 24-31 under U.S.C. §103(a)

Claims 1-4, 6-22 and 24-31 are rejected as unpatentable over Debique in view of Sicola. Appellant respectfully submits that the Examiner has failed to establish a *prima facie* case of obviousness. Each respective related claim set is discussed separately below.

AI. Rejection of Claims 1-4 and 6-12 under U.S.C. §103(a)

Claims 1-4 and 6-12 are rejected as unpatentable over Debique in view of Sicola. Appellant respectfully submits that the Examiner has failed to establish a *prima facie* case of obviousness and respectfully traverse this rejection for the following reasons.

Claims 1-4 and 6-12 are directed to a method that is practiced in a storage network. Performance of the method updates a first replica held by a physically remote device in the storage network. The method includes the step of instructing a first data replication facility of a first electronic device in the storage network to log one or more writes to a local storage device when the first replica held by the physically remote storage device *cannot be updated due to a detected error condition in the storage network.* In accordance with the recited method, the first electronic device further determines if *the detected error condition still exists in the storage network that prevents updating of the first replica held* by the physically remote storage device. The method further includes the step of instructing the first data replication facility of the first electronic device to replicate data corresponding to the one or more writes identified in a log to generate a second replica upon the determination by the first electronic device that the first replica held by the physically remote storage device can be upgraded due to a removal of the detected error condition. The second replica is outputted from the first electronic device in accordance with a communication protocol to a second data replication facility of the second electronic device of the physically remote storage device in the storage network to update the first replica. Neither the Debique reference nor the Sicola reference alone or in combination detract from the patentability of Claims 1-4 and 6-12.

The Debique patent teaches a system for verifying the proper operation of a replication facility, that is, a replica reconciliation tool. The verification system disclosed by the Debique patent operates on a pair wise basis between a first replica and a second replica within the distributed system after the remote replica is updated. In other words, Debique discloses a verification strategy to verify proper multi-master replication (i.e., the remote storage devices are updated) of logical structures and does not disclose, teach or suggest detection and handling of an error condition in a storage network that *prevents updating* of a replica held by the remote storage device.

In brief, the verification system of the Debique patent verifies that the name space of an object set has been correctly reconciled amongst two replicas (i.e., it verifies that both replicas have the same named objects). In addition, the system verifies that correct propagation of knowledge of changes has occurred amongst replicas in a particular replica set (i.e., it verifies that changes in one replica are known to the other replica). Before the verification system of the Debique patent is run to verify proper replication, several conditions must first be met. *See,* column 4, lines 23-40 of Debique. Furthermore, in operation, the system of Debique teaches that if it is determined that there is not an object with the same ID in the remote replica, a log maintained at the local replica is examined. In particular, the log is examined to determine if there is a modified object, deleted object or renamed object log entry for the identified object. If a log entry is not found in the local log, a remote log is searched for such log entries. The log entries explain the absence of the object; and thus, no error has occurred.

In other words, Debique provides methods and systems to determine if an error occurred during replication and as such a replica held by a remote storage device was updated although possibly incorrectly. Debique is not concerned with, amongst other steps, identifying an error condition that *prevents* updating of the remote replica or when the remote replica cannot be updated. The systems and methods taught by Debique are initiated upon completion of the replication process after the remote replicas has been updated. Accordingly, Applicants contend the Debique patent does not teach or suggest the step of instructing a first data replication facility of a first electronic device in a storage network to replicate data corresponding to one or more writes identified in a log to generate a second replica upon determination by the first electronic device the first replica held by the physically remote storage device can be updated

due to a removal of the detected error condition that prevents updating of the first replica held by the physically remote storage device, as recited in claim 1.

Sicola teaches the use of remote copy sets. A remote copy set as defined by Sicola is the pairing of volumes between a local storage array and a remote storage array. The pairing of a local volume and a remote volume is referred to throughout Sicola as a "remote copy set". Sicola defines a remote copy set as consisting of two same sized volumes, one on the local array, and one on the remote array. *See,* column 8, lines 59-61 of Sicola. Sicola further teaches that when all links between local and remote storage sites are down, or when the remote pair of array controllers are inoperative and the remote storage array is inaccessible to the local site then write operations from the local host are directed to both a local storage array and a log unit. *See,* Column 14, lines 12-29 of Sicola.

During the remote outage, Sicola teaches that extents and data from the local site are both written to a log unit associated with the local site. When access to the remote site is restored, the log unit is "replayed" to the remote site. Replaying the log, sends all commands and data to the remote site "partner" in the original transaction order to all remote copy sets associated with the log unit. A merging operation is performed by the system of Sicola to return a remote copy set (both local and remote members) to the same data state after link restoration or remote site restoration. A "mergeback" operation is performed by the system of Sicola to restore the local site back to the same state as the remote site during site fail back. A local log and a remote log are used to replay the transactions for the merge and mergeback functions, respectively. *See,* Column 14, lines 44-59 of Sicola.

More specifically, Sicola is concerned with queuing logged data to replay the logged data in a manner similar to the well known use of "instant reply" used to replay a portion of a sporting event. Replaying the log as taught by Sicola does not mean or equate to replicating data in the log to generate a second replica. Replaying the log as taught by Sicola means or equates to the emptying of a first-in-first-out buffer or queue. In fact, Sicola discloses that even after re-establishment of communications with the remote site the local site continues to write to the log, but the host writes are delayed to allow the merge to catch up to the log writes. More

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specifically, a "command throttle" routine is executed to slow down host writes so the merge can take place. *See*, Column 15, line 22-24 of Sicola.

Nevertheless, neither Debique nor Sicola, alone or in combination, perform a step of instructing the first data replication facility of the first electronic device to *replicate* data corresponding to the one or more writes identified in the log to *generate a second replica* upon determination by the first electronic device that the first replica held by the physically remote storage device can be updated due to a removal of the detected error condition. More specifically, Debique teaches the use of a log to record an absence of an object and thus no occurrence of an error. Hence, Debique does not teach or suggest such a step. Further, Sicola teaches a replay operation. The replay operation taught by Sicola does not *generate* a second replica. Rather, the replay operation of Sicola performs a first-in-first-out queuing operation so that the upon re-establishment of communication to the remote site, data in the log is read from and queued in a first-in-first-out manner to return a remote copy site (both local and remote members) to the same data state. Hence, the Debique patent in view of the Sicola patent, fails to teach or suggest each and every step of Claims 1-4 and 6-12.

Furthermore, the Office Action continues by expressing it would have been obvious to one of ordinary skill in the art at the time the invention was made to have modified Debique to include detection of a communication link failure. Although this statement is merely conclusory the Office Action continues and states that one of ordinary skill in the art at the time of the invention was made would have modified Debique by the teaching of Sicola to include detection of the communication link failure because it provides for transmission means in a remote network database environment. Nonetheless, this last statement is again merely conclusory in addition to circular and does not properly characterize the relevant inquiry as to what one of ordinary skill in the art at the time of the invention confronted by the same problems as the inventor with no knowledge of the claimed invention would have selected the various elements from Debique and Sicola and combine them in the manner as claimed in the instant application.

More specifically, the combination of the disclosure of Debique in view of Sicola taken as a whole would suggest to one of ordinary skill in the art a replication system and method having a tool to verify replication integrity at the completion of the generation and the

distribution of one or more replicas. Overall, the Debique reference is concerned with replication integrity, that is, whether the replica is stored in the right location and is complete or whether bits are dropped during transmission. Debique is not concerned with how to address any failure in the communication network that prevents a replica held by a physically remote storage device from being updated. In contrast, Sicola teaches the use of redundant features, that is, redundant controllers and replication facilities along with redundant transmission links in a point to point fashion so that for the super majority of the time a remote replica can always be updated. Nevertheless, Sicola does recognize that on rare occasions based on their system architecture and configuration a remote storage device may not be accessible from a local host and therefore teaches to queue all local writes in a FIFO until communications with the remote storage device is re-established. Then upon re-establishment of communications with the remote storage device the FIFO is emptied. That is, the data held by the FIFO is transmitted to the remote storage device and is *not replicated* to update the remote host.

A significant technical difference exists between emptying a FIFO by transmitting its content to the remote storage device and replicating the contents of a log and then sending the replicated data to the remote storage device. Therefore, Applicants respectfully contend no motivation or suggestion exists, implicitly or otherwise, to combine the Debique and Sicola reference.

Still further, in the Advisory Action mailed September 29, 2005, the Examiner contends the term "cannot be" or "can be" found in Claims 1, 19 and 31 suggest optional use of the steps to follow and thereby is not given any patentable weight. In support of this assertion MPEP §§ 2106 and 2173.05(i) are cited. However, neither of the cited sections of the MPEP support such a position. MPEP § 2106 addresses the patentability of computer related inventions while MPEP §2173.05(i) confirms the acceptable use of negative limitations. Accordingly, Applicants contend the Examiner has errored in not affording these limitations patentable weight and has errored in interpreting these claim features in the context of the other features recited in each independent claim.

Accordingly, Applicants contend the Examiner failed to establish a *prima facie case* of obviousness with which to reject Claims 1-4 and 6-12. Neither Debique nor Sicola, alone or in combination, teach or suggest each and every step of Claims 1-4 and 6-12 nor does a sufficient teaching, suggestion or motivation exist to combine the references as suggested by the Examiner.

Claims 2-4 and 6-12 depend from independent Claim 1 and are therefore patentable for at least the same reasons discussed above.

Accordingly, Applicants respectfully request reconsideration and withdrawal of the rejection of Claims 1-4 and 6-12 under 35 U.S.C. §103(a).

AII.   Rejection of Claims 13-18 under 35 U.S.C. §103(a)

Claims 13-18 stand rejected under 35 U.S.C. §103(a) as being unpatentable over Debique in view of Sicola. Applicants respectfully traverse this rejection for the following reasons.

Claims 13-18 are directed to a method to handle a communication link failure in a computer network. The computer network includes a number of programmable electronic devices and each of the programmable electronic devices operates as a host device for a data replication facility for replicating data amongst the programmable electronic devices. The method includes the step of instructing each data replication facility of each programmable electronic device to enter a logging routine should the host device of the data replication facility detect the communication link failure. The method further includes the step of instructing each data replication facility of each programmable electronic device that initiated the logging routine to generate a replica for each local write identified in the log upon re-establishment of the communication link.

Neither Debique nor Sicola, alone or in combination teach or suggest, amongst other steps, the step of instructing *each* data replication facility of *each* of the *plurality of programmable* electronic devices to enter a logging routine should a host device of the data replication facility detect a communication link failure. Debique is concerned with logging to provide an indication to the verification tool that the absence of a replicated object is not an

error. Sicola is concerned with logging write operations on a <u>single</u> host, not each host of a replication facility, when <u>two</u> communication link failures occur.

More specifically, nowhere does Debique or Sicola, alone or in combination, teach or suggest instructing *each* data replication facility of *each* of the *plurality of programmable* electronic devices to enter a logging routine upon determination of a link failure. In contrast, the method of Claims 13-18 instruct each data replication facility of each of the plurality of the programmable electronic devices to enter a logging routine should a host device of the data replication facility detect a communication link failure.

Neither the Debique patent nor the Sicola patent, alone or in combination, teach or suggest each and every step of Claims 13-18. Hence, the Debique patent in view of the Sicola patent, fails to teach or suggest each and every step recited in Claims 13-18.

Furthermore, the final Office Action continues by expressing it would have been obvious to one of ordinary skill in the art at the time the invention was made to have modified Debique to include detection of a communication link failure. Although this statement is merely conclusory the final Office Action continues and states that one of ordinary skill in the art at the time of the invention was made would have modified Debique by the teaching of Sicola to include detection of the communication link failure because it provides for transmission means in a remote network database environment. Nonetheless, this last statement is again merely conclusory in addition to circular and does not properly characterize the relevant inquiry as to what one of ordinary skill in the art at the time of the invention confronted by the same problems as the inventor with no knowledge of the claimed invention would have selected the various elements from Debique and Sicola and combine them in the manner as claimed in the instant application.

More specifically, the combination of the disclosure of Debique in view of the disclosure of Sicola taken as a whole would suggest to one of ordinary skill in the art a replication system and method having a tool to verify replication integrity at the completion of the generation and the distribution of one or more replicas. Overall, the Debique reference is concerned with replication integrity, that is, whether the replica is stored in the right location and is complete or whether bits are dropped during transmission. Debique is not concerned with how to address

any failure in the communication network that prevents a replica held by a physically remote storage device from being updated. In contrast, Sicola teaches the use of redundant features, that is, redundant controllers and replication facilities along with redundant transmission links in a point to point fashion so that for the super majority of the time a remote replica can always be updated. Nevertheless, Sicola does recognize that on rare occasions based on their system architecture and configuration a remote storage device may not be accessible from a local host and therefore teaches to queue all local writes in a FIFO until communications with the remote storage device is re-established. Then upon re-establishment of communications with the remote storage device the FIFO is emptied. That is, the data held by the FIFO is transmitted to the remote storage device and is *not replicated* to update the remote host.

A significant technical difference exists between emptying a FIFO by transmitting its content to the remote storage device and replicating the contents of a log and then sending the replicated data to the remote storage device. Therefore, Applicants respectfully contend no motivation or suggestion exists, implicitly or otherwise, to combine the Debique and Sicola reference.

Still further, in the Advisory Action mailed September 29, 2005, the Examiner contends the term "cannot be" or "can be" found in Claims 1, 19 and 31 suggest optional use of the steps to follow and thereby is not given any patentable weight. In support of this assertion MPEP §§ 2106 and 2173.05(i) are cited. However, neither of the cited sections of the MPEP support such a position. MPEP § 2106 addresses the patentability of computer related inventions while MPEP §2173.05(i) confirms the acceptable use of negative limitations. Accordingly, Applicants contend the Examiner has errored in not affording these limitations patentable weight and has errored in interpreting these claim features in the context of the other features recited in each independent claim.

Accordingly, Applicants contend the Examiner failed to establish a *prima facie case* of obviousness with which to reject Claims 13-18. Neither Debique nor Sicola, alone or in combination, teach or suggest each and every step of Claims 13-18 nor does a sufficient teaching, suggestion or motivation exist to combine the references as suggested by the Examiner.

Claims 14-18 depend from independent Claim 13 and are therefore patentable for at least the same reasons discussed above.

Accordingly, Applicants respectfully request reconsideration and withdrawal of the rejection of Claims 13-18 under 35 U.S.C. §103(a).

AIII.   Rejection of Claims 19-22 and 24-30 under 35 U.S.C. §103(a)

Claims 19-22 and 24-30 stand rejected under 35 U.S.C. §103(a) as being unpatentable over Debique in view of Sicola. Applicants respectfully traverse this rejection for the following reasons.

Claims 19-22 and 24-30 are directed to a readable medium holding programmable electronic device readable instructions to perform a method in a storage network to update a first replica held by a physically remote storage device in the storage network. The medium includes instructions to instruct a first data replication facility of a first programmable electronic device in the storage network to enter a first state to log one or more writes to a local storage device when the first replica held by the physically remote storage device cannot be updated due to a detected error condition that does not allow transmission of data to the physically remote storage device. The medium includes instructions to determine at the first programmable electronic device if the first replica held by the physically remote storage device can be updated due to an abatement of the detected error condition. The medium further includes instructions to instruct the first data replication facility of the first programmable electronic device to replicate data corresponding to the one or more writes identified in the log in order to create a second replica upon determination by the first programmable electronic device that the first replica held by the physically remote storage device can be updated. Further instructions held by the medium allow for outputting of the second replica in accordance with a communication protocol from the first programmable electronic device to a second data replication facility of a second programmable electronic device in communication with the physically remote storage device in the storage network to update the first replica.

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Neither the Debique patent nor the Sicola patent, alone or in combination, teach or suggest each and every element of Claims 19-22 and 24-30. More specifically, neither Debique nor Sicola teach or suggest the generation of a second replica by replicating data corresponding to one or more writes identified in a log. Debique teaches the use of a log to provide an indication to a replication verification tool that the absence of a replicated object is not an error. Sicola is concerned with queuing data in a FIFO and later emptying the FIFO by writing the contents of the FIFO to the remote storage device or in the words of Sicola to replay the logged data. Replaying the log as taught by Sicola <u>does not</u> mean or equate to replicating data in the log to generate a second replica. Replaying the log as taught by Sicola means or equates to the emptying of the FIFO. In fact, Sicola discloses that even after re-establishment of communications with the remote site the local site continues to write to the log, but the host writes are delayed to allow the merge to catch up to the log writes. More specifically, a "command throttle" routine is executed to slow down host writes so the merge can take place. *See*, Column 15, line 22-24 of Sicola. Sicola teaches the use of the log as a FIFO and does not teach or suggest replication of the content of the FIFO.

Neither the Debique patent nor the Sicola patent, alone or in combination, teach or suggest each and every step of Claims 19-22 and 24-30. Furthermore, the final Office Action continues by expressing it would have been obvious to one of ordinary skill in the art at the time the invention was made to have modified Debique to include detection of a communication link failure. Although this statement is merely conclusory the final Office Action continues and states that one of ordinary skill in the art at the time of the invention was made would have modified Debique by the teaching of Sicola to include detection of the communication link failure because it provides for transmission means in a remote network database environment. Nonetheless, this last statement is again merely conclusory in addition to circular and does not properly characterize the relevant inquiry as to what one of ordinary skill in the art at the time of the invention confronted by the same problems as the inventor with no knowledge of the claimed invention would have selected the various elements from Debique and Sicola and combine them in the manner as claimed in the instant application.

More specifically, the combination of the disclosure of Debique in view of the disclosure of Sicola taken as a whole would suggest to one of ordinary skill in the art a replication system

and method having a tool to verify replication integrity at the completion of the generation and the distribution of one or more replicas. Overall, the Debique reference is concerned with replication integrity, that is, whether the replica is stored in the right location and is complete or whether bits are dropped during transmission. Debique is not concerned with how to address any failure in the communication network that prevents a replica held by a physically remote storage device from being updated. In contrast, Sicola teaches the use of redundant features, that is, redundant controllers and replication facilities along with redundant transmission links in a point to point fashion so that for the super majority of the time a remote replica can always be updated. Nevertheless, Sicola does recognize that on rare occasions based on their system architecture and configuration a remote storage device may not be accessible from a local host and therefore teaches to queue all local writes in a FIFO until communications with the remote storage device is re-established. Then upon re-establishment of communications with the remote storage device the FIFO is emptied. That is, the data held by the FIFO is transmitted to the remote storage device and is *not replicated* to update the remote host.

A significant technical difference exists between emptying a FIFO by transmitting its content to the remote storage device and replicating the contents of a log and then sending the replicated data to the remote storage device. Therefore, Applicants respectfully contend no motivation or suggestion exists, implicitly or otherwise, to combine the Debique and Sicola reference.

Still further, in the Advisory Action mailed September 29, 2005, the Examiner contends the term "cannot be" or "can be" found in Claims 1, 19 and 31 suggest optional use of the steps to follow and thereby is not given any patentable weight. In support of this assertion MPEP §§ 2106 and 2173.05(i) are cited. However, neither of the cited sections of the MPEP support such a position. MPEP § 2106 addresses the patentability of computer related inventions while MPEP §2173.05(i) confirms the acceptable use of negative limitations. Accordingly, Applicants contend the Examiner has errored in not affording these limitations patentable weight and has errored in interpreting these claim features in the context of the other features recited in each independent claim.

Hence, the Debique patent in view of the Sicola patent, fails to establish a *prima facie case* of obviousness with which to reject Claims 19-22 and 24-30.

Claims 20-22 and 24-30 depend from independent Claim 1 and are therefore patentable for at least the same reasons.

Accordingly, Applicants respectfully request reconsideration and withdrawal of the rejection of Claims 19-22 and 24-30 under 35 U.S.C. §103(a).

AIV.   Rejection of Claim 31 under 35 U.S.C. §103(a)

Claim 31 stands rejected under 35 U.S.C. §103(a) as being unpatentable over Debique in view of Sicola. Applicants respectfully traverse this rejection in view of the following arguments.

Claim 31 is directed to a method to update a first replica held by a physically remote storage device in a storage network. Performance of the method in the storage network instructs a first data replication facility of a first electronic device in the storage network to log one or more writes to a local storage device when the first replica held by the physically remote storage device cannot be updated due to a detected error condition in the storage network. The method includes the step of determining at the first electronic device if the detected error condition still exists in the storage network that prevents updating of the first replica held by the physically remote storage device. Performance of the method instructs the first date replication facility of the first electronic device to replicate data corresponding to the one or more writes identified in a log to generate a second replica upon determination by the first electronic device that the first replica held by the physically remote storage device can be updated due to a removal of the detected error condition that prevents updating of the first replica held by the physically remote storage device. Performance of the method instructs the first replication facility of the first electronic device to halt logging of the one or more writes to the local storage device upon determination that the first replica can be updated and the first electronic device outputs the second replica in accordance with a communication protocol to a second data replication facility of a second electronic device of the physically remote storage device in the storage network to

update the first replica. Neither the Debique patent nor the Sicola patent, alone or in combination teach or suggest each and every step of claim 31.

More specifically, neither Debique nor Sicola teach or suggest the generation of a second replica by replicating data corresponding to one or more writes identified in a log. Debique teaches the use of a log to provide an indication to a replication reconciliation tool that the absence of a replicated object is <u>not</u> an error. Sicola is concerned with queuing logged data to replay the logged data in a manner similar to the well know use of "instant reply" used to replay a portion of a sporting event. Replaying the log as taught by Sicola <u>does not</u> mean or equate to replicating data in the log to generate a second replica. Replaying the log as taught by Sicola means or equates to the emptying or writing the contents of a FIFO to a remote storage device. In fact, Sicola discloses that even after re-establishment of communications with the remote site the local site continues to write to the log, but the host writes are delayed to allow the merge to catch up to the log writes. More specifically, a "command throttle" routine is executed to slow down host writes so the merge can take place. *See*, Column 15, line 22-24 of Sicola. Sicola teaches the use of the log as a FIFO and does not teach or suggest replication of the contents of the FIFO.

Neither the Debique patent nor the Sicola patent, alone or in combination, teach or suggest each and every step of Claim 31. Furthermore, the final Office Action continues by expressing it would have been obvious to one of ordinary skill in the art at the time the invention was made to have modified Debique to include detection of a communication link failure. Although this statement is merely conclusory the final Office Action continues and states that one of ordinary skill in the art at the time of the invention was made would have modified Debique by the teaching of Sicola to include detection of the communication link failure because it provides for transmission means in a remote network database environment. Nonetheless, this last statement is again merely conclusory in addition to circular and does not properly characterize the relevant inquiry as to what one of ordinary skill in the art at the time of the invention confronted by the same problems as the inventor with no knowledge of the claimed invention would have selected the various elements from Debique and Sicola and combine them in the manner as claimed in the instant application.

More specifically, the combination of the disclosure of Debique in view of the disclosure of Sicola taken as a whole would suggest to one of ordinary skill in the art a replication system and method having a tool to verify replication integrity at the completion of the generation and the distribution of one or more replicas. Overall, the Debique reference is concerned with replication integrity, that is, whether the replica is stored in the right location and is complete or whether bits are dropped during transmission. Debique is not concerned with how to address any failure in the communication network that prevents a replica held by a physically remote storage device from being updated. In contrast, Sicola teaches the use of redundant features, that is, redundant controllers and replication facilities along with redundant transmission links in a point to point fashion so that for the super majority of the time a remote replica can always be updated. Nevertheless, Sicola does recognize that on rare occasions based on their system architecture and configuration a remote storage device may not be accessible from a local host and therefore teaches to queue all local writes in a FIFO until communications with the remote storage device is re-established. Then upon re-establishment of communications with the remote storage device the FIFO is emptied. That is, the data held by the FIFO is transmitted to the remote storage device and is *not replicated* to update the remote host.

A significant technical difference exists between emptying a FIFO by transmitting its content to the remote storage device and replicating the contents of a log and then sending the replicated data to the remote storage device. Therefore, Applicants respectfully contend no motivation or suggestion exists, implicitly or otherwise, to combine the Debique and Sicola reference.

Still further, in the Advisory Action mailed September 29, 2005, the Examiner contends the term "cannot be" or "can be" found in Claims 1, 19 and 31 suggest optional use of the steps to follow and thereby is not given any patentable weight. In support of this assertion MPEP §§ 2106 and 2173.05(i) are cited. However, neither of the cited sections of the MPEP support such a position. MPEP § 2106 addresses the patentability of computer related inventions while MPEP §2173.05(i) confirms the acceptable use of negative limitations. Accordingly, Applicants contend the Examiner has errored in not affording these limitations patentable weight and has errored in interpreting these claim features in the context of the other features recited in each independent claim.

Hence, the Debique patent in view of the Sicola patent, fails to establish a *prima facie case* of obviousness with which to reject Claim 31.

Accordingly, Applicants respectfully request reconsideration and withdrawal of the rejection of Claim 31 under 35 U.S.C. §103(a).

VIII. CLAIMS

A copy of the claims involved in the present appeal is attached hereto as Appendix A.

IX. EVIDENCE

No evidence pursuant to §§ 1.130, 1.131, or 1.132 or entered by or relied upon by the examiner is being submitted.
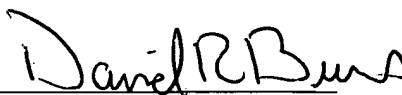
X. RELATED PROCEEDINGS

A copy of the Examiner's Answer to Appeal Brief in U.S. Patent Application Serial No. 09/988853 is included as Appendix B.

Applicant believes no fee is due with this statement. However, if a fee is due, please charge our Deposit Account No. 12-0080, under Order No. SMQ-082CN2 from which the undersigned is authorized to draw.
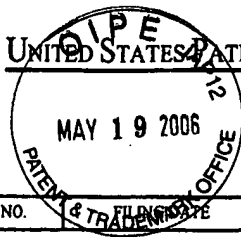
Dated: May 19, 2006   Respectfully submitted,

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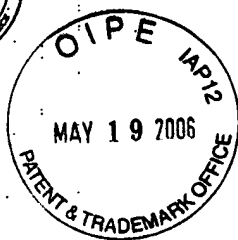Alexandria, Virginia 22313-1450
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BETIT, JACOB F

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BEFORE THE BOARD OF PATENT APPEALS
AND INTERFERENCES

Application Number: 09/988,853
Filing Date: November 19, 2001
Appellant(s): TELOH ET AL.

David R. Burns
For Appellant

EXAMINER'S ANSWER

This is in response to the appeal brief filed 26 September 2005 appealing from the Office action

mailed 29 June 2004.

(1) Real Party in Interest

A statement identifying by name the real party in interest is contained in the brief.

(2) Related Appeals and Interferences

The examiner is not aware of any related appeals, interferences, or judicial proceedings which will directly affect or be directly affected by or have a bearing on the Board's decision in the pending appeal.

(3) Status of Claims

The statement of the status of claims contained in the brief is correct.

(4) Status of Amendments After Final

The appellant's statement of the status of amendments after final rejection contained in the brief is correct.

(5) Summary of Claimed Subject Matter

The summary of claimed subject matter contained in the brief is correct.

(6) Grounds of Rejection to be Reviewed on Appeal

The appellant's statement of the grounds of rejection to be reviewed on appeal is correct.

(7) Claims Appendix

The copy of the appealed claims contained in the Appendix to the brief is correct.

(8) Evidence Relied Upon

6,629,264 B1	Sicola et al.	09-2003
6,324,654 B1	Wahl et al.	11-2001
6,209,002 B1	Gagne	03-2001

(9) Grounds of Rejection

The following ground(s) of rejection are applicable to the appealed claims:

The following is a quotation of the appropriate paragraphs of 35 U.S.C. 102 that form the basis

for the rejections under this section made in this Office action:

A person shall be entitled to a patent unless –

(e) the invention was described in (1) an application for patent, published under section 122(b), by another filed in the United States before the invention by the applicant for patent or (2) a patent granted on an application for patent by another filed in the United States before the invention by the applicant for patent, except that an international application filed under the treaty defined in section 351(a) shall have the effects for purposes of this subsection of an application filed in the United States only if the international application designated the United States and was published under Article 21(2) of such treaty in the English language.

Claims 1-4, 6-10, 12-16, 18, 20-23, 25-29, 31-35, 37-41, 43-46, and 48-50 are rejected

under 35 U.S.C. 102(e) as being anticipated by Sicola et al. (U.S. patent No. 6,629,264).

As to claim 1, Sicola et al. teaches in a storage network (see column 7, lines 1-11), a

method for replicating data in the storage network (see column 1, lines 5-10), the method

comprising the steps of:

identifying to a first data replication facility at a first programmable electronic device in

the storage network a first structure and a second structure held by a storage device locally

accessible to the first programmable electronic device (see abstract, where "storage device" is

read on "data storage array", and an array holds two or more storage structures);

instructing the first data replication facility to logically group the first structure and the

second structure from the storage device to create a group (see column 20, lines 38-55, where

"group" is read on "set");

generating a replica of the group at the first data replication facility (see column 8, line 52

through column 9, line 7); and

forwarding the replica in accordance with a communication protocol from the first data

replication facility at the first programmable electronic device to a second data replication

facility at a second programmable electronic device in the storage network for storage by a

second storage device (see column 6, lines 1-13, and see column 9, lines 1-5).

As to claim 8, Sicola et al. teaches a method for replicating data (see column 1, lines 6-

10) in a storage network to update one or more data structures of a remote storage device (see

column 6, line 66 through column 7, line 12), the method comprising the steps of:

instructing a first data replication facility of a first electronic device in the storage

network to logically associate a first data structure and a second data structure held by a locally

accessible storage device, wherein the logical association defines a group (see abstract and

column 20, lines 38-55, where "storage device" is read on " data storage array, an array holds

two or more storage structures, and "group" is read on "set");

generating a replica of the first data structure and the second data structure as the group

(see column 8, line 52 through column 9, line 7); and

outputting the replica in accordance with a data communications protocol from the first

replication facility of the first electronic device to a second replication facility of a second electronic device in the storage network to update the one or more data structures of the remote storage device (see column 6, lines 1-13, and see column 9, lines 1-5).

As to claim 13, Sicola et al. teaches a readable medium holding programmable electronic device readable instructions (see column 9, lines 10-34, where "programmable electronic device readable instructions" is read on "software" and it is well know in the art that software is stored on a readable medium) for executing a method for replicating data in a storage network (see column 1, lines 5-10); the method comprising the steps of:

identifying to a first data replication facility at a first programmable electronic device in the storage network a first structure and a second structure held by a storage device locally accessible to the first programmable electronic device (see abstract, where "storage device" is read on "data storage array", and an array holds two or more storage structures);

instructing the first data replication facility to group the first structure and the second structure from the storage device (see column 20, lines 38-55, where "group" is read on "set");

generating a replica of the first structure and the second structure as a group at the first data replication facility (see column 8, line 52 through column 9, line 7); and

asserting the replica in accordance with a communication protocol from the first data replication facility at the first programmable electronic device to a second data replication facility at a second programmable electronic device in the storage network for storage by a second storage device locally accessible to the second programmable electronic device (see column 6, lines 1-13, and see column 9, lines 1-5).

As to claims 2 and 14, <u>Sicola et al.</u> teaches further comprising the step of, forwarding

from the first data replication facility at the first Programmable electronic device to the second

data replication facility at the second programmable electronic device information identifying a

storage location at the second storage device at which to store the replica (see column 20, lines

41-44).

As to claims 3 and 15, <u>Sicola et al.</u> teaches wherein the first programmable electronic

device forwards the replica to the second programmable electronic device in a synchronous

manner (see column 11, line 27 through column 12, line 3).

As to claims 4 and 16, <u>Sicola et al.</u> teaches wherein the first programmable electronic

device forwards the replica to the second programmable electronic device in an asynchronous

manner (see column 12, line 6 through column 13, line 41).

As to claims 6, 12, and 18, <u>Sicola et al.</u> teaches wherein the first programmable electronic

device and the second programmable electronic device in the storage network operate without a

volume manager facility (There is no mention of a "volume manager facility" in the disclosed

specification of <u>Sicola et al.</u>, therefore, it is assumed that <u>Sicola et al.</u> do not use a "volume

manager facility").

As to claims 7 and 20, <u>Sicola et al.</u> teaches wherein the first structure comprises a first

logical volume and the second structure comprises a second logical volume (see column 3, lines 18-26).

As to claim 9, <u>Sicola et al.</u> teaches further comprising the steps of, packaging with the replica, information identifying one or more storage locations for storage of the replica on the remote storage device (see column 20, lines 41-44).

As to claim 10, <u>Sicola et al.</u> teaches further comprising the steps of, instructing the first data replication facility to preserve a write ordering of the first data structure and the second data structure in the group (see column 12, lines 49-50).

As to claim 21, <u>Sicola et al.</u> teaches, in a storage network (see column 7, lines 1-11), a method to create a replica of selected data in the storage network (see column 1, lines 5-10), the method comprising the steps of:

    instructing a first data replication facility at a first electronic device in the storage network to track changes to one or more storage locations of a first storage medium that correspond to the selected data (see column 12, lines 17-34);

    instructing the first data replication facility to generate the replica of the selected data based on the tracked changes to the one or more locations of the first storage medium (see column 12, lines 47-59);

    placing the replica of the selected data in a data structure (see column 12, lines 50-52); and

forwarding the replica of the selected data in accordance with a communication protocol from the data structure to a second data replication facility at a second electronic device in the storage network for storage of the replica on a second storage medium by the second electronic device (see column 12, lines 47-50).

As to claim 33, Sicola et al. teaches, a readable medium holding programmable electronic device readable instructions (see column 9, lines 10-34, where "programmable electronic device readable instructions" is read on "software" and it is well know in the art that software is stored on a readable medium) for executing a method to create a replica of selected data in a storage network (see column 1, lines 5-10), the method comprising the steps of:

instructing a first data replication facility at a first programmable electronic device in the network to track changes to one or more areas of a first storage device in communication with the first programmable electronic device, wherein the one or more areas correspond to the selected data (see column 12, lines 17-34);

instructing the first data replication facility to generate the replica of the selected data based on the tracked changes to the one or more areas of the first storage device (see column 12, lines 47-59);

placing the replica of the selected data in a data structure (see column 12, lines 50-52); and

forwarding the replica of the selected data in accordance with a communication protocol from the data structure to a second data replication facility at a second programmable electronic device in the storage network for storage of the replica on a second storage device in

communication with the second programmable electronic device (see column 12, lines 47-50).

As to claims 22 and 34, Sicola et al. teaches further comprising the step of, sending an instruction from the first data replication facility at the first electronic device to the second data replication facility at the second electronic device to initiate a process for receiving and storing the replica of the selected data (see column 9, lines 21-34, where it is inherent that the PPRC manager must send an instruction to the second device in order to initiate the connection and heartbeat with the remote controller).

As to claims 23 and 35, Sicola et al. teaches further comprising the step of, halting the generation of the replica of the selected data until the replica held by the data structure is forwarded from the data structure to the second data replication facility at the second electronic device in the storage network (see column 14, line 33 through column 15, line 58).

As to claims 25 and 37, Sicola et al. teaches further comprising the step of, identifying to the first data replication facility at the first electronic device in the storage network the selected data held by the first storage medium in communication with the first electronic device (see column 20, lines 38-55).

As to claims 26 and 38, Sicola et al. teaches wherein the data structure comprises a queue (see column 14, lines 45-58, where "queue" is read on "log").

As to claims 27 and 39, <u>Sicola et al.</u> teaches wherein the first electronic device performs

the forwarding of the replica of the selected data from the data structure to the second data

replication facility at the second electronic device in a first in first out (FIFO) manner (see

column 14, lines 59-65, where "FIFO" is read on "in order").

As to claims 28 and 40, <u>Sicola et al.</u> teaches wherein the first electronic device performs

the forwarding of the replica of the selected data from the data structure to the second data

replication facility at the second electronic device in a synchronous manner (see column 11, line

27 through column 12, 3).

As to claims 29 and 41, <u>Sicola et al.</u> teaches wherein the first electronic device performs

the forwarding of the replica of the related data from the data structure to the second data

replication facility of the second electronic device in an asynchronous manner (see column 12,

line 5 through column 13, line 41).

As to claims 31 and 43, <u>Sicola et al.</u> teaches wherein the first electronic device and the

second electronic device operate without a volume manager facility (There is no mention of a

"volume manager facility" in the disclosed specification of <u>Sicola et al.</u>, therefore, it is assumed

that <u>Sicola et al.</u> do not use a "volume manager facility").

As to claims 32 and 44, <u>Sicola et al.</u> teaches wherein the one or more locations of the first

storage medium comprise one of a track, a sector, a logical volume and a logical offset into the

first storage medium (see column 19, line 58 through column 20, line 4).

As to claim 45, <u>Sicola et al.</u> teaches a method for replicating data (see column 1, lines 6-10) in a distributed network to update a remote storage device with data from a local storage device (see column 6, line 66 through column 7, line 12), the method comprising the steps of:

instructing a first data replication facility of a first electronic device in the distributed network to track one or more locations of a local storage device that correspond to one or more identified volumes (see column 12, lines 17-34);

grouping each of the one or more identified volumes into a group by the first data replication facility (see column 20, lines 38-55, where "group" is read on "set");

generating a replica of the group at the first data replication facility (see column 12, lines 47-59); and

asserting the replica in accordance with a communication protocol toward a second replication facility of a second electronic device in the distributed network to update the remote storage device (see column 12, lines 47-50).

As to claim 46, <u>Sicola et al.</u> teaches further comprising the step of, sending a command from the first data replication facility to the second data replication facility of the second electronic device to initiate receipt of the replica (see column 9, lines 21-34, where it is inherent that the PPRC manager must send a command to the second device in order to initiate the connection and heartbeat with the remote controller).

As to claims 48, <u>Sicola et al.</u> teaches further comprising the step of, sending from the

second data replication facility to the first data replication facility an indication that the update to

the remote storage device completed (see column 11, lines 60-63).

As to claim 49, <u>Sicola et al.</u> teaches further comprising the step of, writing the replica to a

local queue for temporary storage before the asserting of the replica in accordance with the

communication protocol toward the second replication facility of the second computer occurs

(see column 12, lines 18-34).

As to claim 50, <u>Sicola et al.</u> teaches further comprising the step of, identifying to the first

data replication facility of the first electronic device in the distributed network the one or more

volumes of the data for the replicating of data to update the remote storage device (see column

20, lines 38-55).

The following is a quotation of 35 U.S.C. 103(a) which forms the basis for all obviousness

rejections set forth in this Office action:

> (a) A patent may not be obtained though the invention is not identically disclosed or described as set forth in
> section 102 of this title, if the differences between the subject matter sought to be patented and the prior art are
> such that the subject matter as a whole would have been obvious at the time the invention was made to a person
> having ordinary skill in the art to which said subject matter pertains. Patentability shall not be negatived by the
> manner in which the invention was made.

Claims 5, 11, 17, 19, 30, and 42 are rejected under 35 U.S.C. 103(a) as being

unpatentable over <u>Sicola et al.</u> (U.S. patent No. 6,629,264 B1) in view of <u>Wahl et al.</u> (U.S. patent

No. 6,324,654 B1).

As to claims 5, 11, and 17 <u>Sicola et al.</u> does not teach wherein the communication

protocol comprises the Transmission Control Protocol/Internet Protocol (TCP/IP) protocol suite.

<u>Wahl et al.</u> teaches a computer network remote data mirroring system that writes update

data both to a local data device and to a remote system (see abstract) in which he teaches wherein

the communication protocol comprises the Transmission Control Protocol/Internet Protocol

(TCP/IP) protocol suite (see column 5, lines 14-38).

Therefore, it would have been obvious to a person having ordinary skill in the art at the

time the invention was made to have modified <u>Sicola et al.</u> to include wherein the

communication protocol comprises the Transmission Control Protocol/Internet Protocol

(TCP/IP) protocol suite.

It would have been obvious to a person having ordinary skill in the art at the time the

invention was made to have modified <u>Sicola et al.</u> by the teachings of <u>Wahl et al.</u> because

wherein the communication protocol comprises the Transmission Control Protocol/Internet

Protocol (TCP/IP) protocol suite would allow the transfer of data for the data replication system

to go over common networks such as LANs, the Internet, and other WANs.

As to claim 19, <u>Sicola et al.</u> does not teach wherein the first, structure comprises a first

group of records and second structure comprises a second group of records.

<u>Wahl et al.</u> teaches wherein the first, structure comprises a first group of records and

second structure comprises a second group of records (see abstract and column 12, lines 38,

where it is understood in the art that a database contains a plurality of records, and if it is spread

across several disks each disk with contain a group of the database records).

Therefore, it would have been obvious to a person having ordinary skill in the art at the time the invention was made to have modified Sicola et al. to include wherein the first, structure comprises a first group of records and second structure comprises a second group of records.

It would have been obvious to a person having ordinary skill in the art at the time the invention was made to have modified Sicola et al. by the teachings of Wahl et al. because wherein the first, structure comprises a first group of records and second structure comprises a second group of records would ensure chronological coherency to be maintained on the mirror devices (see Wahl et al., column 12, lines 15-28).

As to claims 30 and 42, Sicola et al. does not teach wherein the communication protocol comprises the Transmission Control Protocol/Internet Protocol (TCP/IP) protocol suite.

Wahl et al. teaches wherein the communication protocol comprises the Transmission Control Protocol/Internet Protocol (TCP/IP) protocol suite (see column 5, lines 14-38).

Therefore, it would have been obvious to a person having ordinary skill in the art at the time the invention was made to have modified Sicola et al. to include wherein the communication protocol comprises the Transmission Control Protocol/Internet Protocol (TCP/IP) protocol suite.

It would have been obvious to a person having ordinary skill in the art at the time the invention was made to have modified Sicola et al. by the teachings of Wahl et al. because wherein the communication protocol comprises the Transmission Control Protocol/Internet Protocol (TCP/IP) protocol suite would allow the transfer of data for the data replication system to go over common networks such as LANs, the Internet, and other WANs.

Claims 24, 36, 47, and 51 are rejected under 35 U.S.C. 103(a) as being unpatentable over

Sicola et al. (U.S. patent No. 6,629,264 B1) in view of Gagne et al. (U.S. patent No. 6,209,002

B1).

As to claims 24 and 36, Sicola et al. does not teach further comprising the step of,

packaging with the replica of the selected data information that identifies a storage location for

storage of the replica of the selected data on the second storage medium.

Gagne et al. teaches a data storage facility that mirrors data onto at least three different

remote sites (see abstract) in which he teaches further comprising the step of, packaging with the

replica of the selected data information that identifies a storage location for storage of the replica

of the selected data on the second storage medium (see column 8, lines 22-52).

Therefore, it would have been obvious to a person having ordinary skill in the art at the

time the invention was made to have modified Sicola et al. to include further comprising the step

of, packaging with the replica of the selected data information that identifies a storage location

for storage of the replica of the selected data on the second storage medium.

It would have been obvious to a person having ordinary skill in the art at the time the

invention was made to have modified Sicola et al. by the teachings of Gagne et al. because

further comprising the step of, packaging with the replica of the selected data information that

identifies a storage location for storage of the replica of the selected data on the second storage

medium would enable the copy program to transfer data to the appropriate destination (see

Gagne et al., column 8, lines 30-32).

As to claim 47, <u>Sicola et al.</u> does not teach further comprising the step of, packaging with the replica information that indicates a storage location for each volume in the replica for storage on the remote storage device.

<u>Gagne et al.</u> teaches further comprising the step of, packaging with the replica information that indicates a storage location for each volume in the replica for storage on the remote storage device (see column 8, lines 22-52).

Therefore, it would have been obvious to a person having ordinary skill in the art at the time the invention was made to have modified <u>Sicola et al.</u> to include further comprising the step of, packaging with the replica information that indicates a storage location for each volume in the replica for storage on the remote storage device.

It would have been obvious to a person having ordinary skill in the art at the time the invention was made to have modified <u>Sicola et al.</u> by the teachings of <u>Gagne et al.</u> because further comprising the step of, packaging with the replica information that indicates a storage location for each volume in the replica for storage on the remote storage device would (see column 8, lines 22-52).

As to claim 51, <u>Sicola et al.</u> as modified, teaches wherein the information comprises one of a volume name and a volume number (see <u>Sicola et al.</u>, column 12, lines 37-55).

(10) Response to Argument

A. Rejection of claims 1-4, 6-10, 12-16, 18, 20-23, 25-29, 31-35, 37-41, 43-46, and 48-50 under 35 U.S.C. §102(e)

Appellant makes arguments traversing the rejection of the independent claims as a group. Appellant appears to only have one general argument against the rejection of the independent claims and that is that all of the independent claims "require the element of logically grouping two elements held by a storage device ... into a group", which Appellant alleges is not taught by Sicola et al. The examiner submits that independent claims 21 and 33 make no mention of grouping any kind. Therefore, the features upon which Appellant's arguments rely are not recited in the rejected claims 21 and 33. Although the claims are interpreted in light of the specification, limitations from the specification are not read into the claims. See *In re Van Geuns*, 988 F.2d 1181, 26 USPQ2d 1057 (Fed. Cir. 1993).

The only features of claims 21 and 33 that resemble any combining or grouping of any sort recite "instructing a first data replication facility ... to track changes to one or more storage locations of a first storage medium that correspond to said selected data", in claim 21 and "instructing a first data replication facility ... to track changes to one or more areas of a first storage device ... wherein the one or more areas correspond to said selected data", in claim 33. The examiner contends these limitations are not the same as logically grouping structures, elements, volumes, or even data and actually hold a much broader meaning. One reasonable interpretation of these limitations only requires instructing the first facility to track changes to ONE storage location (or area) of a first storage medium (or device). In this case it is not even possible to form a group, let alone the fact that no grouping step is being claimed. Certainly no requirement of grouping exactly two elements is made in this claim as is argued by Appellant.

For the reasons given above and the lack of protest toward any other part of the rejection of claims 21 and 33 or their dependents, the examiner submits that at least the rejection of these

claims and their dependents was proper. Appellant, by not making any other arguments, appears

to concede to remaining parts of the examiner's rejection.

In response to Appellant's arguments that "Sicola fails to disclose this step of grouping

two elements held by a storage device into a group", the arguments were fully considered but

were not deemed persuasive. Sicola et al. recites "logical unit members S1 through Sn (where

'n' can be any number [in this case 2]) of an association set 'S' are established by a system user"

(see column 20, lines 41-43).

This organizing of logical units (elements) makes it so that all of the writes made to the

local system or systems (not the backup systems, see figure 2, reference number 218) happen in

the same order to the remote system or systems (backup systems, see figure 2, reference number

219). Because of this, if a write is made to S2 and then later made to S1 (both part of figure 2,

reference number 203) when the remote copy is made to Sn` (or the remote copy set of S1 and

the remote copy set of S2, both part of figure 2, reference number 213) the write to this "remote

copy set" is made in the same order as it was made locally (i.e. write to S2` and then S1`). More

benefits of grouping two logical units (that are not mirrors of each other and therefore not the

same as remote copy sets), are listed at column 19, line 58 through column 20, line 4.

Appellant's arguments are often directed toward the fact that "an associate set consists of

pairs of volumes" and alleges that these volumes have to exist on different sites. The examiner

traverses this notion. In making this argument Appellant refers to column 19, lines 58-60, which

read, "An association set is a group of logical units (a set of one [or] more remote copy sets) on a

local or remote pair of array controllers". This statement seems to be misinterpreted by

Appellant. Appellant appears to reason that an association set is nothing more than a larger

remote copy set. However, when looking at this statement one can conclude that Sicola et al.

envisioned grouping a plurality local volumes that are already paired up in remote copy sets. So

that when backups were made from these local volumes they would go in order to the

corresponding members of the remote copy set. Sicola et al. defines a remote copy set as "a pair

of same-sized volumes, one on the local array, and one on the remote array" that are both written

two every time there is a write to the local volume (see column 8, lines 51-63). Unlike a remote

copy set an association set is a group of one or more logical units (same as volumes, see column

8, line 53) that do not have the same data. Members of an association set share different

properties such as a log so that "writes during a 'mini-merge' operation (a merge following write

history logging) and asynchronous micro-merge writes are replayed in the same order received

from the host".

Appellant argues "a remote copy set contains data that are physically in two arrays, a

local array and a remote array, that reside on two different storage device[s]". In Appellant's

arguments it is insinuated that the examiner refers to the "remote copy set" of Sicola et al. to

teach the feature of "instructing a first data replication facility to logically group said first

structure data structure, and said second structure from said storage device to create a group".

The examiner makes note of the fact that neither in the rejection to the claims nor in any

response to arguments did the examiner refer to "remote copy sets" when showing that Sicola et

al. taught the claimed limitation of "instructing the first data replication facility to logically

group the first structure and the second structure from the storage device to create a group" or

any of the similar limitations in independent claims 8, 13, or 45. This rejection of this limitation

refers to column 20 lines 38-55 which is discussing "association sets" and how they are created.

Appellant later argues that the "association sets" cannot be used to teach the limitations in

question because "Sicola defines an association set as a group of logical units (i.e. a set of one or

more remote copy sets) on a local or remote pair of array controllers with attributes for logging

and failover selectable by a system user". The examiner notes that a remote copy set is not the

same as a logical unit because a remote copy set includes "volumes (or LUNs [logical units, see

column 8, line 64]) on a local array as being paired with counterpart volumes on a remote array"

(see column 8, lines 53-55). Sicola et al. is saying "a set of one or more remote copy sets"

because these logical units that are being grouped now were previously grouped with the other

member of their "remote copy set". That is, the logical unit members S1 through Sn of the

association set are also each a member of their own remote copy set and are paired with logical

unit members S1` through Sn` on a remote site. This makes it so that writes going to the

members of the association set will also go in the same order to the corresponding members of

their remote copy sets.

A remote copy set is created for the sole purpose of deciding where the backup copy of a

particular logical unit should be sent (see column 8, line 50 through column 9, line 7). An

association set is created so that changes to two or more local logical units will be consistent

when they are "played back" to the remote copy sets (see column 3, lines 50-53). Therefore

while in a remote copy set both logical units are copies of each other, in an association set the

logical units are not copies but logical units that have writes that are synchronized with

eachother. "[T]he present invention provides a mechanism of associating a set of volumes to

synchronize the logging to the set of volumes so that [] the log is consistent when it is 'played back' to the remote site" (column 3, lines 50-53). "[A]ssociation sets are employed by the present invention to provide failure consistency by causing the group of logical units/volumes to all fail at the same time, ensuring a point in time consistency on the remote site" (column 3, lines 24-27).

B. Rejection of claims 5, 11, 17, 19, 30 and 42 under 35 U.S.C. §103(a)

Appellant's arguments directed towards the rejection of claims 5, 11, 17, 19, 30, and 45 reiterate deficiencies Appellant feels were made in the rejection of the independent claims, and do not address any new points. Therefore the examiner submits that if the rejection of the independent claims is deemed proper, the rejection of claims 5, 11, 17, 19, 30, and 45 should also be upheld.

C. Rejection of claims 24, 36, 47, and 51 under 35 U.S.C. §103(a)

Appellant's arguments directed towards the rejection of claims 24, 36, 47, and 51 reiterate deficiencies Appellant feels were made in the rejection of the independent claims, and do not address any new points. Therefore the examiner submits that if the rejection of the independent claims is deemed proper, the rejection of claims 24, 36, 47, and 51 should also be upheld.

(11) Related Proceeding(s) Appendix

No decision rendered by a court or the Board is identified by the examiner in the Related

Appeals and Interferences section of this examiner's answer.

For the above reasons, it is believed that the rejections should be sustained.

Respectfully submitted,

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Examiner
Art Unit 2164

Conferees:

Charles Rones
Supervisory Patent Examiner
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An appeal conference was held on 06 December 2005, and it was agreed to proceed to
the board of appeals.

APPENDIX A

Claims Involved in the Appeal of Application Serial No. 09/988,854

1.   In a storage network, a method to update a first replica held by a physically remote storage device in said storage network, said method comprising the steps of:

instructing a first data replication facility of a first electronic device in said storage network to log one or more writes to a local storage device when said first replica held by said physically remote storage device cannot be updated due to a detected error condition in the storage network;

determining at said first electronic device if said detected error condition still exists in the storage network that prevents updating of said first replica held by said physically remote storage device;

instructing said first data replication facility of said first electronic device to replicate data corresponding to the one or more writes identified in said log to generate a second replica upon determination by said first electronic device that said first replica held by said physically remote storage device can be updated due to a removal of said detected error condition that prevents updating of said first replica held by said physically remote storage device; and

outputting said second replica in accordance with a communication protocol from said first electronic device to a second data replication facility of a second electronic device of said physically remote storage device in said storage network to update said first replica.

2.   The method of claim 1, further comprising the step of, identifying to said first data replication facility of said first electronic device which of said one or more writes to said local storage device should not be logged when said physically remote storage device cannot be updated.

3.   The method of claim 1, further comprising the step of, instructing said first data replication facility of said first electronic device to automatically output said second replica to said second replication facility once generation of said second replica is complete.

4.   The method of claim 1, further comprising the step of, instructing said first replication facility of said first electronic device to prompt an operator of said first replication facility in order to obtain authorization for said output of said second data replica to said second data replication facility of said second electronic device to update said first replica.

5.   The method of claim 1, further comprising the steps of,

        instructing said first replication facility of said first electronic device to halt logging of said one or more writes to said local storage device upon said determination that said first replica can be updated; and

        instructing said first replication facility of said first electronic device to initiate generation of said second replica upon said determination that said first replica can be updated.

6.   The method of claim 1, further comprising the step of, instructing said second replication facility of said second electronic device to log said one or more writes to a second local storage device of said second electronic device.

7.   The method of claim 6, further comprising the steps of,

        detecting an available communication link in said storage network between said first electronic device and said second electronic device to transport data between said first electronic device and said second electronic device;

        prompting said system operator to select a primary replication facility and a secondary replication facility from amongst said first replication facility of said first electronic device and said second replication facility of said second electronic device;

        upon selection by said system operator, instructing said primary replication facility to generate said second replica of data identified in said log; and

        instructing said primary replication facility to output said second replica for transmission to said secondary replication facility via said available communication link to update said first replica.

8.   The method of claim 1, further comprising the step of, forwarding from said
first data replication facility of said first electronic device to said second data replication facility
at said second electronic device information identifying a storage location on said physically
remote storage device for storage of said second replica.

9.   The method of claim 1, wherein said outputting from said first data
replication facility of said first electronic device to said second data replication facility of said
second electronic device occurs in a synchronous manner.

10.   The method of claim 1, wherein said communication protocol comprises the
Transmission Control Protocol/Internet Protocol (TCP/IP) protocol suite.

11.   The method of claim 1, wherein said first electronic device and said second electronic
device operate without a volume manager facility.

12.   The method of claim 1, wherein said log comprises a bitmap holding one or more bits,
wherein each of the one or more bits in the bit map indicates a storage location written to on the
local storage device.

13.   In a computer network having a plurality of programmable electronic devices, wherein
each of said plurality of programmable electronic devices operates as a host device for a data
replication facility for replicating data among said plurality of programmable electronic devices,
a method to handle a communication link failure in said computer network, said method
comprising the steps of,
        instructing each said data replication facility of each of said plurality
of programmable electronic devices to enter a logging routine should said host device of said
data replication facility detect said communication link failure, wherein said logging routine
halts said replicating of data by said replication facility of said host device and said replication
facility of said host device identifies in a log each local write of said host device that detects said
communication link failure; and
        instructing each said data replication facility of each of said plurality of

programmable electronic devices that initiated said logging routine to generate a replica for each said local write identified in said log upon reestablishment of said communication link.

14.   The method of claim 13, further comprising the steps of,

grouping each said replica into a single data set; and

forwarding said single data set in accordance with a communication protocol from a first of said plurality of programmable electronic devices to a second of said plurality of programmable electronic devices.

15.   The method of claim 14, further comprising the step of, packaging with said single data set information identifying a storage location for storage of said single data set on a storage device of said second of said plurality of programmable electronic devices.

16.   The method of claim 14, wherein said first of said plurality of programmable electronic devices forwards said single data set in a synchronous manner.

17.   The method of claim 14, wherein said communication protocol comprises the Transmission Control Protocol/Internet Protocol (TCP/IP) protocol suite.

18.   The method of claim 13, wherein each of said plurality of programmable electronic devices in said computer network operate without a volume manager facility.

19.   A readable medium holding programmable electronic device readable instructions to perform a method in a storage network to update a first replica held by a physically remote storage device in said storage network, said method comprising the steps of:

instructing a first data replication facility of a first programmable electronic device in said storage network to enter a first state to log one or more writes to a local storage device when said first replica held by said physically remote storage device cannot be updated due to a detected error condition that does not allow transmission of data to said physically remote storage device;

determining at said first programmable electronic device if said first replica held by said physically remote storage device can be updated due an abatement of the detected error condition;

instructing said first data replication facility of said first programmable electronic device to replicate data corresponding to the one or more writes identified in said log in order to create a second replica upon determination by said first programmable electronic device that said first replica held by said physically remote storage device can be updated; and

outputting said second replica in accordance with a communication protocol from said first programmable electronic device to a second data replication facility of a second programmable electronic device in communication with said physically remote storage device in said storage network to update said first replica.

20.   The readable medium of claim 19, further comprising the step of, identifying to said first data replication facility of said first programmable electronic device which of said one or more writes to said local storage device should not be logged when said physically remote storage device cannot be updated.

21.   The readable medium of claim 19, further comprising the step of, instructing said first data replication facility of said first programmable electronic device to automatically transmit said second replica to said second replication facility once creation of said second replica is complete.

22.   The readable medium of claim 19, further comprising the step of, at said first replication facility of said first programmable electronic device, prompting an operator of said first replication facility to obtain permission for said outputting of said second data replica to said second data replication facility of said second programmable electronic device to update said first replica.

23.   The readable medium of claim 19, further comprising the steps of,

instructing said first replication facility of said first programmable electronic device to exit said first state upon said determination that said first replica can be updated; and

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instructing said first replication facility of said first programmable electronic device to enter a second state to initiate creation of said second replica upon said determination that said first replica can be updated.

24.   The readable medium of claim 19, further comprising the steps of,

detecting a communication link failure in said storage network between said first programmable electronic device and said second programmable electronic device; and

instructing said second replication facility of said second programmable electronic device to enter said first state to log one or more writes to a second local storage device coupled to said second programmable electronic device.

25.   The readable medium of claim 24, further comprising the steps of,

detecting an available communication link in said storage network between said first programmable electronic device and said second programmable electronic device to transport data between said first programmable electronic device and said second programmable electronic device;

prompting said system operator to select a primary replication facility and a secondary replication facility from amongst said first replication facility of said first programmable electronic device and said second replication facility of said second programmable electronic device;

upon selection of said primary replication facility by said system operator, instructing said primary replication facility to enter said second state to create said second replica of data identified in said first state; and

instructing said primary replication facility to output said second replica for transport via said available communication link in said storage network to said secondary replication facility to update said first replica.

26.   The readable medium of claim 19, further comprising the step of, forwarding from said first data replication facility of said first programmable electronic device to said second data replication facility at said second programmable electronic device information identifying a storage location on said physically remote storage device for storage of said second replica.

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27.   The readable medium of claim 19, wherein said outputting from said first data replication facility of said first programmable electronic device to said second data replication facility of said second programmable electronic device occurs in a synchronous manner.

28.   The readable medium of claim 19, wherein said communication protocol comprises the Transmission Control Protocol/Internet Protocol (TCP/IP) protocol suite.

29.   The readable medium of claim 19, wherein said first programmable electronic device and said second programmable electronic device operate without a volume manager facility.

30.   The readable medium of claim 19, wherein said log comprises a bitmap to hold one or more pointers, wherein each of the one or more pointers indicate a location on a storage device written to during said first state.

31.   In a storage network, a method to update a first replica held by a physically remote storage device in said storage network, said method comprising the steps of:
        instructing a first data replication facility of a first electronic device in said storage network to log one or more writes to a local storage device when said first replica held by said physically remote storage device cannot be updated due to a detected error condition in the storage network;
        determining at said first electronic device if said detected error condition still exists in the storage network that prevents updating of said first replica held by said physically remote storage device;
        instructing said first data replication facility of said first electronic device to replicate data corresponding to the one or more writes identified in said log to generate a second replica upon determination by said first electronic device that said first replica held by said physically remote storage device can be updated due to a removal of said detected error condition that prevents updating of said first replica held by said physically remote storage device;
        instructing said first replication facility of said first electronic device to halt logging of said one or more writes to said local storage device upon said determination that said first replica can be updated; and

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outputting said second replica in accordance with a communication protocol from said first electronic device to a second data replication facility of a second electronic device of said physically remote storage device in said storage network to update said first replica.